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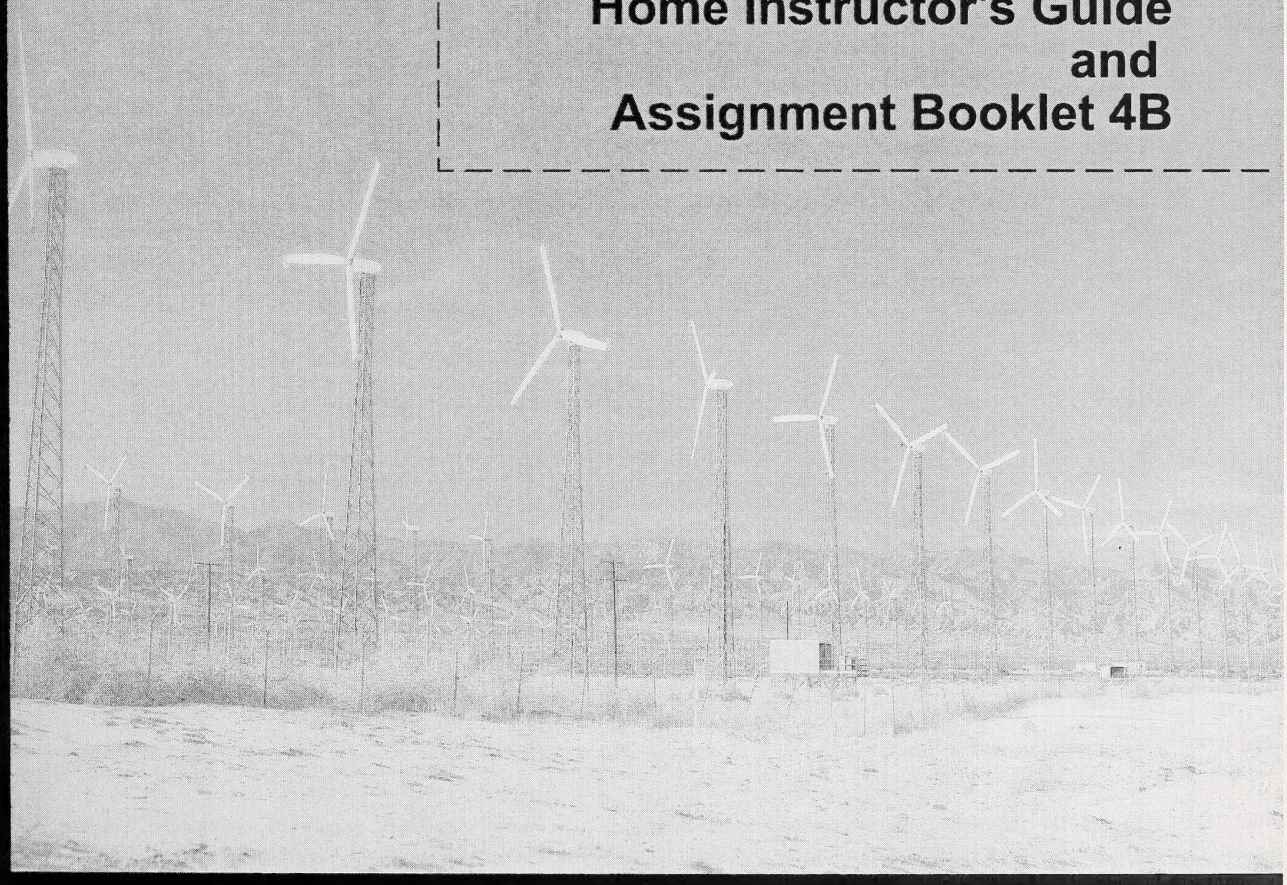
SCIENCE 7

Module 4 Structures and Forces

Home Instructor's Guide and Assignment Booklet 4B



Learning Technologies Branch

Alberta LEARNING

Science 7
Module 4: Structures and Forces
Home Instructor's Guide and Assignment Booklet 4B
Learning Technologies Branch
ISBN 0-7741-2444-X

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The Learning Technologies Branch acknowledges with appreciation the Alberta Distance Learning Centre and Pembina Hills Regional Division No. 7 for their review of this Home Instructor's Guide and Assignment Booklet.

This document is intended for	
Students	✓
Teachers	✓
Administrators	
Home Instructors	✓
General Public	
Other	

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- Alberta Learning, **http://www.learning.gov.ab.ca**
- Learning Technologies Branch, **http://www.learning.gov.ab.ca/ltb**
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Section 3: Making Structures Strong and Stable

In Section 2 the student identified forces within and on structures and how these forces could overcome the strength of structures. In this section the student applies what he or she learned about forces to recognize designs that lead to strong and stable structures. The student identifies what design features can make structures break or tip over.

The following materials will be needed to complete this section.

Section 3: Lesson 1

- scissors
- assorted masses of known weight
- force meter
- index cards (20 × 13 cm)
- glue
- flat plywood (20 × 20 cm)
- string
- 2-speed hair dryer
- paper plates (or index cards)
- about 20 cm of wooden dowel
- masking tape
- 2 balls of modelling clay
- paper clips (or other fasteners and connectors)
- 20 plastic straws
- sand
- sandwich bags

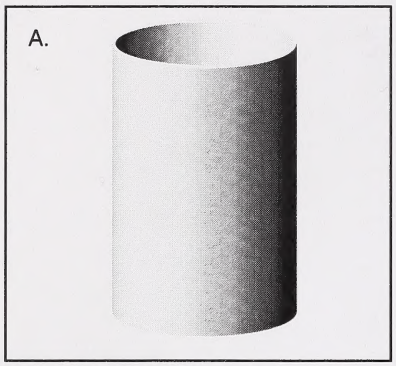
Section 3: Lesson 2

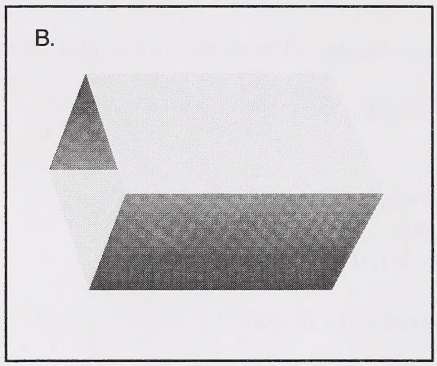
- heavy cardboard
- scissors
- nail
- string
- a small mass
- pencil
- 15 plastic straws
- recipe cards (10 × 15 cm)
- masking tape
- pins
- paper clips
- 250-mL Styrofoam® cup
- sand
- modelling clay
- thread
- ruler
- small tray or plastic container
- 200-g mass
- 4 wooden dowels (of different diameters)
- fork
- graph paper

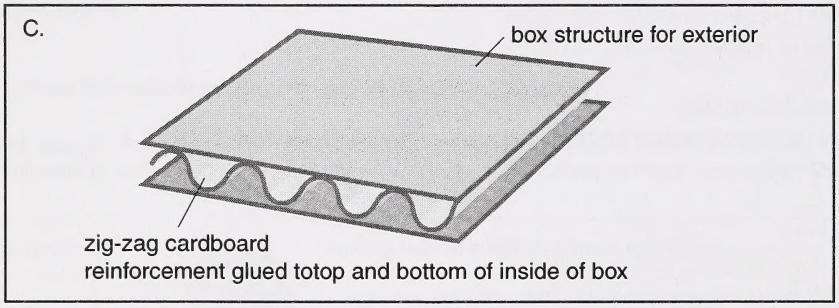
Suggested Answers

Section 3: Lesson 1

9. Answers will vary. Sample sketches are given.

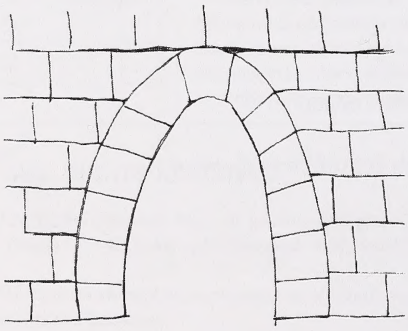




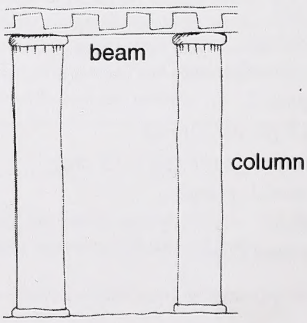


14. **Textbook questions 1.a., 1.b., 2, 4, and 5 of "Topic 6 Review," p. 328**

1. a.



b.



2. Friction holds structural members together at rigid joints and holds foundations to bedrock or subsoil. On the negative side, it opposes motion at mobile joints.

4. a. The towers, their foundations, and the bedrock under the foundations are under compression. Also, when traffic moves over the bridge, the top of the bridge deck is under compression.

   Tension forces act on the cables. Also, when traffic moves over the bridge, the underside of the bridge deck is under tension.

   b. The bridge deck is supported by the abutments (supporting bases) at each end. It is also supported in the centre by the cables supported by the towers.

   c. The tower foundations are placed on bedrock or solid subsoil. The cable strands are tightly wound and firmly anchored at each end.

5. Answers will vary. Sample answers are given.

   a. A pillar, the foundation walls of a house, a stud in a frame wall, a concrete block, and a bicycle seat post are structures designed to withstand compression.

   b. An engine drive shaft, a drill bit, screws, axles, and a torsion bar of an automobile suspension are structures designed to withstand torsion.

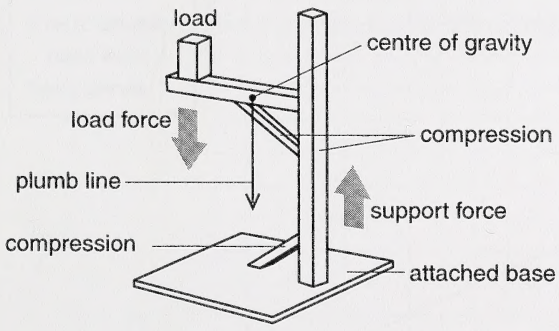
   c. Cloth for sail s, reinforced concrete foundation walls, horizontal beams, hooks holding pictures, and dams are structures designed to withstand shear force.

Section 3: Lesson 2

7. Answers will vary. Sample answers are given.

   a. **Textbook questions 1, 2, and 3 of "Evaluate," p. 335**

   1.



   2. The mass should be distributed so that it is balanced over the base of the tower. This distribution places the centre of gravity above the base of the tower. With the centre of gravity over the base, the structure is stable.

   3. With more sand to support, the structure might tip over or parts might fail due to increased stresses. Tipping could be prevented by enlarging the base to include the centre of gravity. The parts that fail would require you to strengthen those particular parts.

b. **Textbook question 4 of "Extend Your Skills," p. 335**

4. Yes, my prediction was correct. With more sand, the tower tipped over.

11. **Textbook questions 1 or 2 of "Math Connect," p. 338**

1. This dowel covers approximately 20 squares. Each square is equal to 0.01 cm^2. Therefore, the area of the base of the dowel is about $20 \times 0.01\ cm^2 = 0.20\ cm^2$.

2. The area of a circle is $A = \pi r^2$.

The diameter of the base of the dowel is 0.5 cm. Therefore, the radius is 0.25 cm.

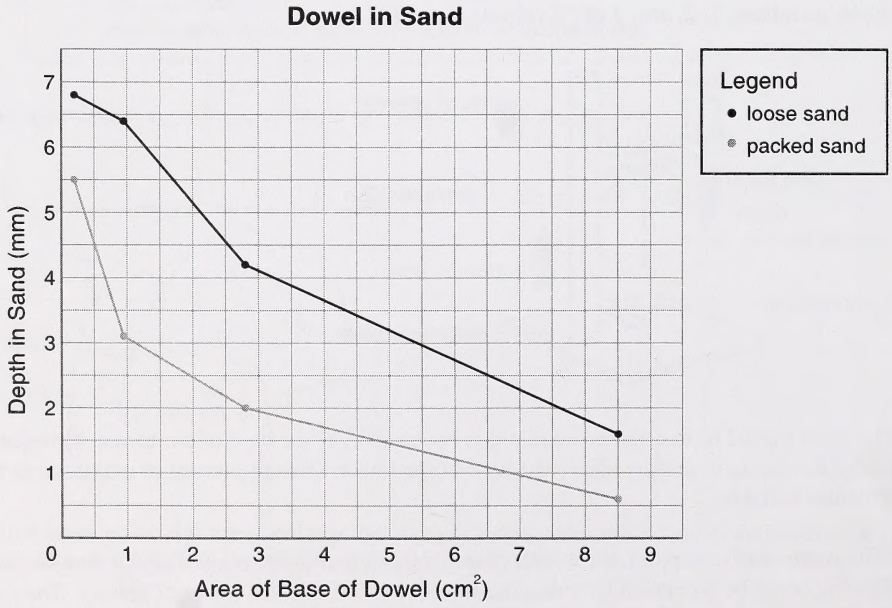
$$A = \pi r^2$$
$$= 3.14 \times (0.25\ cm)^2$$
$$= 0.20\ cm^2$$

A = area
$\pi = 3.14$
r = radius

12. a. **Textbook questions 1 to 6 of "Analyze," p. 338**

1. A line graph proves to be a good choice.

2. Answers will vary. A sample answer is given.



3. The blow from the falling mass was an external force on the sand.

4. The sand supported both a dead load (the weight of the dowel) and a larger live load (the mass acting like a hammer).

5. The falling mass created a compression stress on the sand.

6. Shear stress in the sand was evident by the sand spreading horizontally away from the dowel.

b. **Textbook questions 7 to 12 of "Conclude and Apply," p. 339**

7. Large-diameter dowels do not sink as far in to the sand as smaller-diameter dowels. Distributing the load over a larger area allows the soil to support a larger load.

Note: This answer assumes the sutdent hypothesized along this line.

8. The effect of the force on the surface under a load is greater if the surface is small.

9. A sharp object penetrates a material easier because all of the force acts on one very small area.

10. A builder who needs to build a structure on sandy soil needs to know this information. The design has to spread the load over a large area.

11. Possible reasons are as follows:

    - The sand was not packed equally.
    - The mass was dropped from different heights.

12. The force due to friction increases as the dowel goes deeper into the sand.

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ASSIGNMENT BOOKLET 4B

Science 7
Module 4: Section 3 Assignment and Final Module Assignment

Home Instructor's and Student's Comments:

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(if label is missing or incorrect)

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Teacher's Comments

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Teacher's Signature

Home Instructor: Keep this sheet when it is returned to you as a record of the student's progress.

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- Are all the assignments completed? If not, explain why.
- Has your work been reread to be sure the spelling and details are correct?
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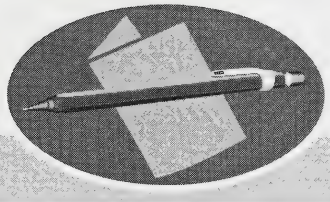
Science 7

Module 4

Structures and Forces

Assignment Booklet 4B



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FOR TEACHER'S USE ONLY

Summary

	Total Possible Marks	Your Mark
Section 3 Assignment	24	
Final Module Assignment	27	
	51	

Teacher's Comments

Science 7
Module 4: Structures and Forces
Assignment Booklet 4B
Learning Technologies Branch

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ASSIGNMENT BOOKLET 4B
SCIENCE 7: MODULE 4
SECTION 3 ASSIGNMENT AND FINAL MODULE ASSIGNMENT

Your mark for this module will be determined in part by how well you do your assignments.

This Assignment Booklet is worth 51 marks out of the total 120 marks for the assignments in Module 4. The value of each assignment and each question is stated in the left margin.

Work slowly and carefully. If you have difficulty, go back and review the appropriate topic.

Be sure to proofread your answers carefully.

24

Section 3 Assignment: Making Stable Structures Strong and Stable

Read all parts of your assignment carefully and record your answers in the appropriate places.

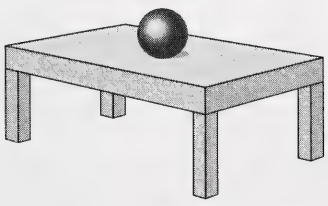
For questions 1 to 3, read each question carefully. Decide which of the choices BEST answers the question. Place your answer in the blank space provided.

(1) _____ 1. Houses in different parts of the world are built according to different standards. Consider a house built in the desert in California. In a freak winter that brought several metres of snow, which would most likely fail?

A. the doors
B. the roof
C. the walls
D. the windows

(1) _____ 2. The same load is placed on four different structures. Which structure will deform downward the most?

A.



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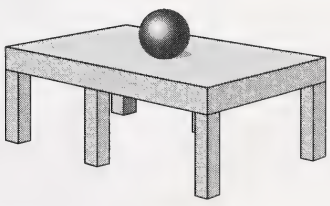

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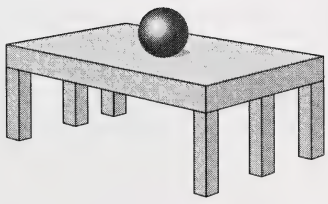

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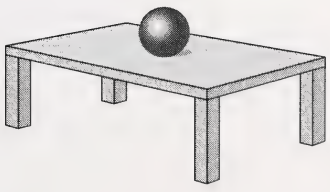


(1) _____ 3. The following diagrams show cross-sections of metal beams. The same amount of the same material is used in each beam. Which will support the largest load?

A.

B.

C.

D.

Return to page 50 of the Student Module Booklet and begin Lesson 2.

4. Identify three structural problems designers encounter and some of the solutions they use.

(3) **Problem 1:** _____

_____

Solution: _____

_____

_____

_____

(3) **Problem 2:** _____

_____

Solution: _____

_____

_____

_____

(3) **Problem 3:** _____

_____

Solution: _____

_____

_____

_____

5. Identify a structure in nature similar to the following.

(1) **box beam:** _____

(1) **flying buttress:** _____

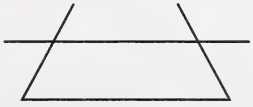
Read question 6 carefully. Decide which of the choices BEST answers the question. Place your answer in the blank space given.

(1) _____ 6. Which of the following shapes is most rigid?

A.

B.

C.

D. 

(2) 7. Sam is riding a bike around a corner. Suddenly, a large brick wall appears right in front of her. How does friction come to Sam's rescue?

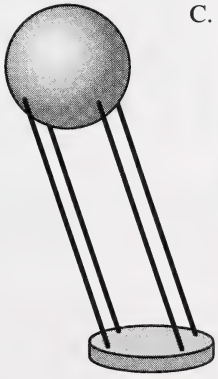
_____

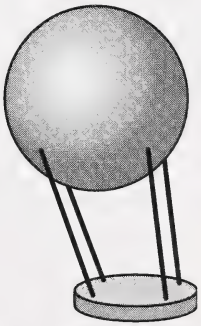
_____

_____

(2) 8. Arrange these structures from most stable to least stable.

A.

B. 

C. 

D.

_____

(2) 9. Describe two ways to increase the force of friction.

(3) 10. How does knowing the location of the centre of gravity of a structure help you to determine its stability?

Return to page 58 of the Student Module Booklet and continue begin the Module Summary

(27)

Final Module Assignment

Read all parts of your assignment carefully and record your answers in the appropriate places.

(2) 1. The ground at a building site consists of soft, spongy soil. Is this site more suitable for a frame structure or a mass structure? Explain why.

(2) 2. Nails and staples usually fasten joints in frame structures, such as houses. Is "The more nails per joint, the better!" a good rule to follow? Explain your answer.

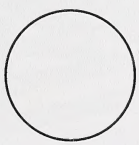
(2) 3. Cabinetmakers use dowelled and dovetail joints to fasten pieces of furniture together. Suggest one method you can use to increase the strength of these joints.

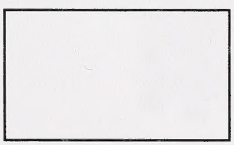
(2) 4. Do structures having the same function always have the same design? Explain your answer.

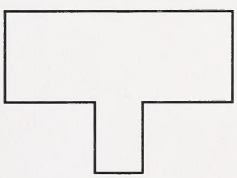
(2) 5. Would concrete make a better support column or a better beam? Why?

(2) 6. How can you calculate the weight of an object on Earth if you know its mass?

(3) 7. For each object, mark the centre of gravity with an X.







(3)

8. Diagram A shows a structure that has just been built. Diagram B shows the structure a few days later. How would you improve the structure? Explain why your improvement will prevent the collapse.

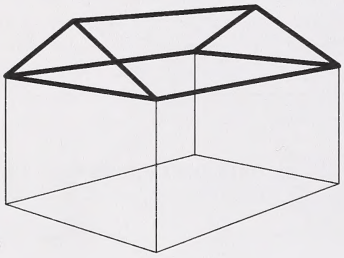


Diagram A

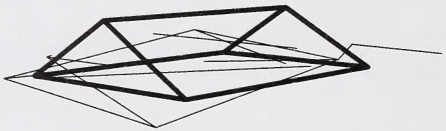
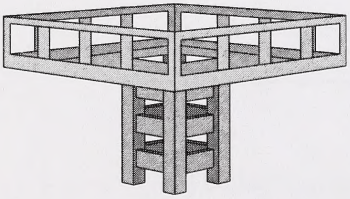


Diagram B

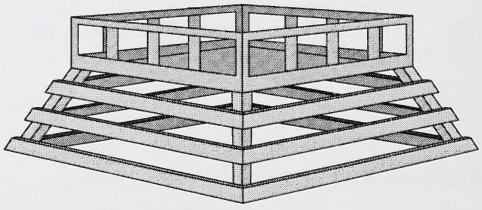
(5)

9. A new climbing structure is being added to a school playground. The playground is for students in grades 1 to 3. Two designs are being considered. You are to decide which design is used. The winning design will be built by volunteers, so there will be no construction costs. The only costs will be for materials. Cost and safety are the two criteria you are to use in making your choice. List your choice and the reasons behind your choice. (**Hint:** Which is cheaper? Why? Which is safer? Why? What is most important?)

Design A



Design B



(2) 10. Cardboard used to make boxes is often corrugated to provide more strength. Explain why corrugated cardboard is stronger than one solid piece of cardboard. Give 2 reasons.

_____

_____

_____

_____

(1) 11. Nails driven into wood usually do not fall out. What keeps the nail in the wood?

_____

_____

Read question 12 carefully. Describe which of the choices BEST answers the question. Place your answer in the blank space provided.

(1) _____ 12. You've spent most of the afternoon piling rocks. You've created a short wall that is about a metre high. You sit down on the wall for a brief rest. What keeps the wall from collapsing under you?

A. density
B. friction
C. gravity
D. tension

Submit your completed Assignment Booklet 4B to your teacher for assessment.

ASSIGNMENT BOOKLET DECLARATIONS

The Student's Declaration is to be signed by a student registered at the Alberta Distance Learning Centre. If the student is under 16, the Supervisor's Declaration is to be signed by the student's supervisor, who is usually a home instructor, teacher, or home-schooling coordinator. Failure to complete this page may invalidate the assignment results.

STUDENT'S DECLARATION

- I have followed the instructions outlined in the Student Module Booklet.
- I have completed the activities to prepare myself for the assignments in this Assignment Booklet.
- I completed the assignments in this Assignment Booklet by myself.

_____

Student's Signature

SUPERVISOR'S DECLARATION

I hereby certify that I have supervised the learning activities completed by _____.

Student's Name

I also certify that to the best of my knowledge the assignments in this Assignment Booklet were completed independently by this student.

_____

Supervisor's Signature

If you, the student or supervisor, have any comments or observations regarding this module, write them in the following space.

_____

_____

_____

_____

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